AN ACCOUNT OF THE SCHEME FOR RENDERING NAVIGABLE The RIVERS FORTH and DEVON,

With ESTIMATES of the EXPENCE.

By JAMES WATT.

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AN
ACCOUNT
OF THE
SCHEME
FOR NAVIGATING
The RIVERS FORTH and DEVON.

THE river Forth, in its courſe from Gartmore to Alloa, a diſtance of twenty ſeven miles, meaſured in a ſtreight line, runs wholly in a level plain of a deep clay ſoil. This extent of the river is naturally divided into two diſtricts; the upper Forth or the freſh water river, which is higher than the riſe of ſpring tides; and the lower Forth or the Tideway.

The river Forth.

The part of the upper Forth, which may moſt eaſily be made navigable, commences near Gartmore, and is ſeperated from the lower Forth by a fall over a rock at Craigforth-dam, where it ends, and the Tideway commences. It meaſures about twenty miles in a ſtreight line, and thirty three by the windings of its channel, which is extremely crooked.

The upper Forth.

Its length.

Nature of its channel.

The Upper Forth has a narrow channel with ſteep ſloping banks; the ſurface of the water is generally twenty feet under the ſurface of the ground, and the river is moſtly deep, there being great diſtricts of it that have always eight or ten feet water; but theſe are ſeperated by ſhallows, ſome of which have not more than two feet water in the ſummer ſeaſon.

Has 3 falls or ſtreams.

The river runs exceeding gently; and except at three places, it has no very ſenſible declivity of ſurface. The lowermoſt of theſe is the fall over the rock at Craigforth-dam, where the ſurface of the upper river is eight feet above that of neap-tides, and four feet and a half above ſpring-tides high-water.

Craigforth-dam.

The ſecond ſtream is at the ford of the Frew, which, meaſuring by the windings of the river, is eighteen miles diſtant from Craigforth-dam. The declivity of ſurface at this place is about three feet, and the length of the ſtream about two hundred yards. The ford appears to be wholly compoſed of gravel, brought thither principally by the burn of Balquhan, which enters there, and is the only ſtream that brings much gravel to the Forth.

Ford of Frew

The third ſtream is at Cardroſs. It is about ſeven miles above the Frew, and is about a mile in length, running partly upon a rock, and partly upon a gravel bottom. The perpendicular fall here is about eight feet and a half when the river is low, and does not exceed ſix feet when there is any freſh.

Ford of Cardro's.

From

Stream at the bridge of Gartmore.

From Cardroſs to a ſtream below the bridge of Gartmore, I know of no impediment to the navigation, except ſome few parts of the river that are rather ſhallow. The ſtream below the bridge is about a mile long, and has a declivity of ſurface of five feet in that ſpace, above which there is half a mile of deep and dead water.

The river Gudie.

The river Gudie enters the Forth about three miles below the Frew; it riſes from the Lough of Menteith, about a mile N. W. from Cardroſs, and runs nearly paralel to the Forth. It is a ſmall river, but running through ſoft ground, has made its channel very deep. It is naturally navigable for the ſpace of four miles from the Forth, to a mill about a quarter of a mile from Thornhill, where there is a fall of a few feet; from that mill upwards to the mill of Cardroſs, it is alſo navigable by a cut of near four miles in length, made for the purpoſe of drainage; ſo that the only impediment to navigation is, the mill-dam below Thornhill, and a ſmall natural fall in the river at that place; where it is thought that the bottom is ſoft, and the riſe could eaſily be lowered, and the cut above it deepened by *Fluſhes*.

Tideway of the Forth.

The tide way of the Forth commences at Craigforth-dam, which is ſixteen miles diſtant from Alloa by the river, and ſeven miles in a ſtreight line.

Is crooked.

It is exceſſively crooked, and its greateſt bendings lye near Stirling, where its channel is narrow when compared with that which it occupies

And has fords in it.

at Alloa. It has ſeveral fords in it above Mannor, which do not permit veſſels drawing above five feet water to paſs over them in neap tides; the tide is three hours later at Craigforth-dam, than at Alloa;

Port of Mannor.

and the port of Mannor is the higheſt acceſſible at all tides for veſſels drawing nine feet water. That port lies above two great turns of the river, and veſſels may often be hindered from coming to it by contrary winds and freſhes.

Port of Cambus.

The port of Cambus lies three miles and three quarters farther down, and below the moſt conſiderable of theſe turns; and the Forth is wider and deeper there.

In the mouth of Devon.

It lies in the mouth of the river Devon, which is three miles and three quarters above Alloa; and has in the harbour nine feet water in low neap tides, and thirteen feet and a half in ſpring-tides. The bottom at the Quay is compoſed of looſe ſtones, and may eaſily be made a foot or two deeper, as it riſes more than that height above the low waters in the Forth oppoſite to it. The bottom of the Devon above the Quay of Cambus, is compoſed of ſhelving rocks, not difficult to quarry, the ſtones of which may be uſeful for building ſuch works as are wanted there.

The river Devon.

The Devon is ſmaller than the upper Forth, and larger than the Gudie; it comes from the eaſt, and runs for many miles through a fine valley, where it has a crooked channel, and the ſurface of the water is not far below that of its banks. Part of it, from Menſtry-dam to Sauchie, a ſpace of three miles by the river, is dead water, except at two places of no great extent, the Weſt-haugh and Coble-crook fords, which together have a fall of about three feet, that may be removed, and this part of the river made the channel of a navigation.

Menſtry-dam

Menſtry-dam is ſituated a mile and three quarters from the Quay of Cambus, and about the ſame diſtance from the port of Mannor; the ſurface of its water is ſeventeen feet and a half, above neap-tides, and fourteen feet above ſpring-tides high water. The channel of the Devon, from this dam to Cambus, is perplexed with dams and ſhallow places where the bottom is rock.

Devon above Sauchie.

Above Sauchie the channel of the Devon is unfit for a navigation, being obſtructed by gravel fords brought in by the burns, but a canal can be cut upon the ſouth ſide of it, from Sauchie to the Rack-mill, a ſpace of four miles. Twenty-three feet of Lockage are required, to raiſe this ſtretch of canal to the level of the ſurface of the Devon, near the Rack-mill; but at leaſt three feet more will be neceſſary, to carry it over the intermediate grounds.

Coal and lime the commodity wanted.

Coals to be had from the Devon.

The commodities, principally wanted in the extenſive countries upon the upper Forth are, lime and pit-coal: the conſumption of both theſe articles is very great, and would be much greater were the expence of carriage lower. They could moſt readily be ſupplyed with the coals from the extenſive ſeams of that mineral which lye upon the Devon from the Coble-crook to the Rack-mill, many of of which are level free, but at preſent they can have no communication with theſe coallieries but by land-carriage, and muſt ſupply themſelves at a higher rate either at Bannockburn, or at Stirling-ſhore, to the laſt of which, coals are brought by the tide-way from Alloa and the coallieries ſituated further down the firth of Forth, where they muſt be bought at the export prices.

Lime.

Lime is ſupplied from Lord Elgin's lime-work upon the Firth, and from the Aberfoil quarries about a mile weſt from the bridge of Gartmore. In the firſt caſe, it is brought to Stirling by water-carriage, and tranſported by land to the countries that want it. The Aberfoil lime is carried only by land, and as the coals with which it is burnt are alſo brought by a long land carriage, it is ſold at a high price, but is of a ſuperior quality to the other.

Advantages of communicating the Devon and Forth.

Were the Upper Forth and the Devon made navigable, and a communication made between them by a canal, or by the tideway, thoſe countrys would be mutually benefited, the one by the ſale of their coals, and the other by obtaining them at a lower rate than they do at preſent. Both the countries upon the Upper Forth and upon the Devon could be ſupplyed with lime from the tideway; and the people upon the Forth would have a choice of taking either that, or the Aberfoil lime, which could be afforded cheaper if the price of coals were lower.

In my report to the Right Honourable the Lords Commiſſioners of Police, in December, 1773, I

have

have propoſed ſeveral plans for the navigation and junction of theſe two rivers. That report has been laid before the public, and has been the ſubject of two meetings of the noblemen and gentlemen intereſted. At the laſt of theſe, upon the 12th inſtant, certain parts of the plans were adopted, and ſome additions made; of which I am now to give an account.

The calculations of the expence of navigating the upper Forth were made, upon the ſuppoſition that the diſtrict between Craigforth-dam and the Drip-bridge is deep water; I am now informed, that there are ſeveral fords in that diſtrict, and in the tideway, betwixt Kildean and the dam. If this be the caſe, and the expence of removing theſe fords ſhall be found to be conſiderable, it may be eligible to lock up at Kildean, and to cut a canal of one mile in length from thence to the river above Craig-Annat, at a place called the Bade. This cut will ſhorten the navigation two miles and a half, and will avoid the moſt perplexed parts of the river; but will be expenſive, as the cutting muſt be deep, and the ground is valuable. I have ſtated the expence of this work in the eſtimates preferably to the other, it being proper, until accurate ſurveys are made, to reckon upon the greateſt expence.

Cut from Bade to Kildean.

Dam at Craig-Annat.

If this cut be made, a dam muſt be erected at Craig-Annat, near the upper end of Craigforth-rock, where the river has a rocky bottom, and ſtones lye at hand; the height of the dam may be four feet, which will raiſe the ſurface of the Upper Forth to twelve feet above neap-tides high water, will ſuperſede all *dredging* below the Frew-ford, and will probably give a ſufficiency of water in the Gudie to the mill near Thornhill

Lock at Frew.

Another lock and dam of five feet fall may be erected at the Frew, which will, without dredging, navigate the river to Cardroſs, and will give dead water near to the top of the ford there.

Lock at Cardroſs.

A third lock and dam of five feet fall, erected at Cardroſs, will give a ſufficiency of water near to the bridge of Gartmore, and whenever there is a freſh in the river, boats will eaſily paſs the ſtream into the dead water above the bridge.

Plan of the Kildean cut is laid aſide.

If the cut from Kildean to Bade is laid aſide, Craigforth-dam muſt be made good, and a lock erected there of eight feet fall. The lock, formerly propoſed at the Frew, may be placed below the mouth of the Gudie, where it will ſave almoſt all the *dredging* in the Forth, and will raiſe a ſufficiency of water in the Gudie. The lock at Cardroſs muſt be placed below the ford, and muſt be of eight feet fall at leaſt.

The Forth and Gudie being navigated by one or other of theſe methods, the next point would be, to connect it with the Devon. The beſt means of effecting this I have ſhewn, in my Report upon that ſubject, to be by a canal through the Kerſes from Menſtry-dam, and upon its level to Craigforth-dam, where it muſt lock down nine feet ſix inches to communicate with the upper Forth. But

Connection with the Devon.

whereas

whereas this canal was principally intended to facilitate the carriage of coals, and it has not been thought probable that ſuch quantities of that commodity would immediately be carried upon it, as would correſpond to the expence. It is now propoſed to execute only that part of it which reaches from Menſtry-dam to Mannor, with the branch to Cambus, to deepen both theſe ports, and to make proper conveniencies to tranſhip the coals, untill experience ſhall ſhow, which is the beſt mode of completing the communication, by locking down to the tideway, or by the canal, to Craigforth-dam.

The canal from Menſtry-dam to Mannor, being very little longer than the canal from the ſame place to Cambus, will ſave three miles ſailing on the tideway to the boats of the upper Forth and Stirling ſhore. The Cambus branch is neceſſary, becauſe, by opening an export ſale to the Devon coallieries, they will be enabled to ſend a greater quantity of tonnage upon the upper parts of the river, and thereby raiſe more tolls.

It is propoſed, to uſe the channel of the Devon from Menſtry dam to Sauchie, to lock up there twenty ſix feet by four locks, and to proceed to Mellock foot, or if need be to the Rack mill, by canal. **Channel of the Devon to be uſed from Menſtrie to Sauchie.**

At leaſt two of the four locks at Sauchie can be cut out of a very good freeſtone rock, which will greatly leſſen their expence, and is accordingly allowed for in the eſtimates. **Locks at Sauchie.**

The dimenſions of the canals are propoſed to be ſixteen feet wide at bottom, with four feet wa- **Dimenſions of the Canal.**

ter,

ter, the locks thirteen feet and a half wide, ſeventy two feet long, and of the falls ſpecified. The navigation upon the Forth may be carried on in boats thirteeen feet wide, from fifty ſix to ſixty feet long, and drawing three feet and a half of water. Such boats, I am informed, navigate the inland rivers of England, and go on the tide-way of the Humber to Hull. Upon the canals, and Devon, the boats will draw much eaſier if they are narrower; but I propoſe, in the view of a junction being effected between the Forth and Devon by locks, that all the bridges and locks upon the Devon canals ſhall be made of the ſame ſize with thoſe upon the Forth. So that the boats conſtructed for the latter may occaſionally ply upon the canals.

The late ſeaſon of the year abſolutely prevents the making minute or accurate ſurveys at preſent. I have therefore made ſome allowances upon that account; and I flatter myſelf, that the eſtimates are near the truth.

The account I have given of the Gudie I have from Mr Moriſon, who is well acquainted with it. I am alſo beholden to him for the levels and deſcription of the Devon and tract above Sauchie, which he ſurveyed in the year 1765. All the other particulars I have examined myſelf, excepting the ſoundings of the tide way of the Forth, which I relate upon information.

I have fixed no price to the land, becauſe the gentlemen intereſted are better judges of that article than I am.

As the map of the Upper Forth is not yet finiſhed, the diſtances of places I have given there, are to be conſidered only as eſtimated, principally by memory, from a plan of it made in the 1767, which I have not ſeen ſince. I therefore recommend to thoſe, who want an exact knowledge of theſe diſtances, to meaſure them upon Mr Moriſon's map of that river, which he is now making out, and will ſoon publiſh.

Edinburgh January 18. 1774.

JAMES WATT.

Particular ESTIMATES of the NAVIGATIONS upon the RIVERS FORTH, DEVON, and GUDIE.

The navigation upon the Upper-Forth.

Cutting a canal from Kildean to the Bade, 1⅛ mile, or 1980 yards long, 12 feet deep, and 16 feet wide at bottom, with ſlopes as 2 to 1, containing 53 cube yards in the running yard, and in all 104,940 cube yards, at 4 d. per yard. .	1749	0	0
Locking up 12 feet by 2 locks at Kildean .	1200	0	0
A bridge over the cut . . .	50	0	0
A pair of ſtop gates at the upper lock -	50	0	0
A dam at Craig-Annat, with ſluices .	100	0	0
	3149	0	0
Incidents ten per cent .	314	0	0
	3463	0	0
Land cut and covered, 60 yards wide, nearly 19 Scotch acres			
The land covered and not needed in perpetuity, is the half of the above, or 9½ acres, which may be reſtored after the earth is cleared off .			

Works from Craigforth to Cardroſs.

A lock and dam at Frew, 5 feet fall .	700	0	0
A lock and dam at Cardroſs, 5 feet fall -	700	0	0
Dam in the glen of Balquhan, to prevent the formation of the Frew-ford	100	0	0
Thirty-three miles towing path, L. 20 each	660	0	0
	2160	0	0
Ten per cent. .	216	0	0
	2370	0	0

ESTIMATE of making the DEVON navigable from the Rack mill to SAUCHIE by a canal; eſtimated from Mr Morriſon's account of it.

Cutting a canal from the Rack-mill to Mellock-foot, one mile, or 1760 yards long, $5\frac{1}{2}$ feet mean depth, 16 feet wide at bottom, with ſlopes as 5 to 3, containing $15\frac{5}{10}$ cube yards in the running yard; and in all 27280 cube yards, at 3 d. each.	341	00	0
One mile towing path and drains, L 30	30	00	0
One tunnel for the land waters .	12	10	0
Paſſing places . . .	20	00	0
	403	10	0
Ten per cent. .	40	7	0
	443	17	0
Land for the cut 9 acres.			
Cutting a canal from Mellock foot to Sauchie of the above dimenſions, 3 miles, or 5280 yards long, containing in all 81840 cube yards at 3 d. each.	1023	00	0
Extra cutting at Tillicoultry bridge .	100	00	0
Three miles towing paths, at L. 30 .	90	00	0
Seven ſmall tunnels . . .	87	10	0
Twenty-ſix feet of lockage moſtly cut out of a good freeſtone rock	1800	00	0
Paſſing places . . .	60	00	0
Four road bridges, at L. 50 each . . .	200	00	0
A ſluice for taking in water	20	00	0
	3380	10	0
Ten per cent.	338	00	0
	3718	0	0
Ground for the canal, 27 acres			

ESTIMATE of making the Devon navigable from Sauchie to Menstry-Dam, with Canals to Cambus and Mannor.

Clearing the fords in the Devon . .	300	00	00
Repairing Menſtry Dam . .	150	00	00
Two pair of ſtop gates . .	100	00	00
Canal from Menſtry-dam to Tillibodie bridge, 1430 yards long, average depth $5\frac{1}{2}$ feet, 16 feet wide at bottom, with ſlopes as 2 to 1, containing $16\frac{2}{10}$ cube yards in the running yard, and in all 23166 cube yards at 3 d. .	289	11	6
Canal from Tillibodie bridge to Mannor, 1960 yards long, containing in all 31752 cube yards at 3 d.	396	18	00
Towing paths and fencing the lands, L. 100 per mile . . .	190	00	00
Enlarging and deepening Mannor pow .	200	00	00
Three bridges at L. 60 . .	180	00	00
Aqueduct over Foulbrigs burn . .	30	00	00
Three ſmall tunnels, L. 10 each .	30	00	00
Paſſing places . . .	40	00	00
Canal from Tillibodie bridge to the Cambus, 1496 yards long, containing 24234 cube yards, at 3 d.	302	18	00
Banking up at the end of it, 100 yards long, containing 3164 cube yards, at 6 d.	79	2	00
Repairing and enlarging Cambus Quay .	300	00	00
One highway bridge	60	00	00
Paſſing-places, towing-paths, and fencing	120	00	00
	2768	9	6
Ten per cent. .	276	17	00
	3045	6	6
Land for the three canals, 23 acres			

The General ESTIMATE.

		£	s	d
The works at Craigforth . .		3463	00	00
The works from Craigforth to Cardroſs .		2370	00	00
The Rackmill canal . .		443	17	00
The canal from Mellock to Sauchie .		3718	10	00
The Menſtrie, Cambus, and Mannor canals		3045	6	6
Sum total of the works.	£	13040	13	6
Land for the Craigforth cut .	19 acres			
Ditto for the Rackmill canal .	9 acres			
Ditto for the Mellock and Sauchie canal	27 acres			
Ditto for the Menſtrie, Cambus, and Mannor canal . .	23 acres			
Sum	78 acres			

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Edinburgh, January 13th, 1774 Years.

At a general meeting of the Noblemen and Gentlemen of the Counties of STIRLING, PERTH, *and* CLACKMANNAN, *held in the Exchange Coffee-houſe, upon Wedneſday the twelth day of January, one thouſand ſeven hundred and ſeventy four Years, in conſequence of an advertiſement publiſhed in the Edinburgh News-papers, on the* 15th *day of December laſt:*

SEDERUNT,

Lord Kaimes
Lord Alva
Mr Alexander Abercromby Sheriff of Clackmannan and Stirling
Mr Erſkine of Grange
Mr Ferrier, for the Duke of Argyle
Mr Jamieſon, for the Town of Stirling
Mr Graham younger of Meiklewood
Mr Hume of Blair-drummond
Mr Callander of Craigforth

LORD KAIMES in the Chair:

THE meeting having received the Report made by Mr Callander of Craigforth, in conſequence of ſeveral conferences he had held with the right honourable Lord Cathcart, and with Meſſieurs Watt and Moriſon engineers and ſurveyors, relative to the plans and eſtimates given in formerly by theſe gentlemen for navigating the rivers Forth, Devon, and Gudie, which are printed, and now in the hands of the publick, and to which Report are added, ſeveral propoſals tending to leſſen greatly the expence of the intended navigation, and alſo to putting the publick ſooner into poſſeſſion of the advantages that may be hoped to reſult from the execution of thoſe works.

RESOLVED,

1*mo*, That the rendering the rivers Forth, Devon, and Gudie navigable, is a meaſure very expedient for the advancement of trade in general, as well as for the improvement of the countries adjacent to the ſaid rivers in particular.

RESOLVED,

2*do*, That it is the opinion of the meeting, that the changes propoſed to be made upon the former printed plans and eſtimates, will greatly leſſen the expence, and abridge the time neceſſary for compleating the intended navigation.

RESOLVED,

3*tio*, That they have now before them ſufficient evidence of the practicability of the ſaid meaſure, to be the ground of an application to Parliament, to obtain an act for the above purpoſe as ſoon as may be.

RESOLVED,

4*to*, That as it has been repreſented to the meeting, that it is very difficult to obtain an act of Parliament, unleſs two thirds at leaſt of the neceſſary expence is provided for: That it be recommended from the chair to the gentlemen compoſing this meeting, to write to their friends and acquaintances, who either, by the ſituation of their ſeveral eſtates, or from other cauſes, are materially intereſted in the ſucceſs of this navigation, to know from them what ſums they are willing to ſubſcribe, in order to carry thoſe abridged plans into execution, and facilitate the paſſing of the intended bill into a Law.

RESOLVED,

5*to*, That Mr Watt and Mr Moriſon be deſired forthwith to draw out, and cauſe to be printed, the heads of, and reaſons for, the abridged plan, with eſtimates of the particular expence attending the ſeveral works, neceſſary for putting the country in immediate poſſeſſion of a navigable communication from the Rack-mill upon the river Devon, to the ports of Cambus and Mannor, upon the tide way of the Forth; and from the tide way to Gartmore upon the Upper-Forth, and to the mill of Cardroſs upon the water of Gudie.

RESOLVED,

6to, That it be recommended to Mr Callander, as ſoon as this paper is printed, to circulate them among the noblemen and gentlemen concerned in the ſucceſs of this navigation ; and that he do write to them at the ſame time, to know their opinion of the utility of the propoſed meaſures, and how far they will give their aſſiſtance towards carrying them into execution.

RESOLVED,

7mo, That, upon allowance obtained from the honourable TRUSTEES for MANUFACTURES, another meeting be held in the hall of their office, on Monday the thirty firſt day of January, one thouſand ſeven hundred and ſeventy four years, in order to receive the ſeveral opinions of the gentlemen intereſted, and to open a ſubſcription for the purpoſes as above-mentioned. And they direct, that theſe reſolutions ſhall be printed and circulated, together with the report and eſtimates.

HENRY HOME.